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Human Dynamics in Smart Cities

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Urban Environment and Smart Cities in Asian Countries

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Human Dynamics in Smart Cities

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Chapter 16

Strengthening Climate Change Governance & Smart City Through Smart Education in Bandung Indonesia



Dewi Kurniasih , Andi Luhur Prianto , Abdillah Abdillah , Umar Congge , and Erwin Akib

16.1 Introduction

Climate change is likely to affect natural resources such as rivers and glaciers in the region, increase natural hazards, and adversely affect livelihoods dependent on natural resources, increasing the vulnerability of cities and thus affecting the overall well-being of society (Sharma et al., 2009). So that, low education, affecting limited livelihood options, poor communication, poor access to modern services, and unfair access to productive resources burden the City area, thereby reducing community capacity to cope with natural disasters related to climate change (Gentle & Maraseni, 2012) Although traditional institutions, as well as natural knowledge (traditional teachings) in the past, played an important role in making communities resilient to the uncertainties posed by global change (Barua et al., 2014). Rapid climate change causes social institutions (communities) and customary knowledge systems to begin to erode. For example, there has been a gradual loss of knowledge related to ecosystems and biodiversity, traditional agricultural practices, and the loss of languages

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which are the only means of transmitting knowledge between generations of people pose a threat to urban resilience and community vulnerability due to climate change impacts (Singh et al., 2009).

Adaptation to climate change has occupied an important position on the government's agenda, especially in the mountainous areas of Bandung City. However, for a successful adaptation strategy, it is important to understand the context-specific factors that enhance or limit adaptive capacity. Many studies have developed adaptation capacity frameworks to assess the capacity of communities to adapt, particularly in the context of vulnerabilities and threats that exist in urban areas. This framework considers access to economic resources, technology, information, skills, agricultural assets, non-agricultural assets, education, health services, gender, and social equality, and so on (IPCC, 2014; Smith et al., 2003; Jones et al., 2010; Dixit et al., 2012). Or in short, realizing a smart city is an important factor to increase and limit people's capacity to adapt. Smart city idea implement in Bandung City, the Government in Bandung City focuses on improving the quality of education, educational policies, and necessary instruments. It is such as the utilization of information systems, and technology in encouraging the improvement of the quality of education in elementary schools to universities. It is an adaptive effort to improve the quality of education through the ability of local communities to deal with climate change (Mursalim, 2017; Widharetno, 2017). Factors of public education, policies, and information systems in implementation of smart cities get the government attention. Therefore, the educational context of the local community that shapes the ability, character, and understanding, at the economic level is a factor that greatly affects the adaptive ability of the community to respond and recover from risks due to the impacts of climate change (IPCC, 2007).

There are many reasons to invest in education as evidenced by the abundance of climate change literature showing that people who are more educated tend to have higher adaptive capacities (Adger & Kelly, 1999; Wamsler et al., 2012; Van der Land & Hummel 2013; Striessnig et al., 2013; Muttarak & Lutz, 2014). Previous researchers have agreed that the most effective long-term defense against the adverse effects of climate change is to strengthen the factors associated with increasing human capital (the education factor). Education can strengthen human resources because it is related to improving health, eradicating extreme poverty, and decreasing population growth to build a smart city. Furthermore, research shows that educated communities are more empowered to recover from natural disasters related to climate change (Brink, 2010). Climate change literature (Magnan, 2010; Watson, 2014) states that education enables people to make well-informed decisions and empowers communities by increasing the set of opportunities available to them, thereby contributing significantly to building adaptive capacity.

Realizing a smart city to adaptive capacity in the people of Bandung City in the West Java region is one of the city development and management strategies that have been pursued in the last 10 years in Bandung City (Mursalim, 2017; Widharetno, 2017). Smart City concept is designed to help various activities and provide easy access to information for the community. This makes the local government system need to be managed properly, accurate information can serve the public to anticipate

unexpected events. Such as facing disaster vulnerability due to climate change in Bandung City. This effort is intended to increase the resilience of urban communities in adaptive capacity efforts through education as a way to increase community capacity and open up community participation in the development and planning of Bandung City, Indonesia (Mursalim, 2017; Widharetno, 2017).

Therefore, this study considers education as an important indicator of adaptive capacity (Adger & Agne, 2004). Efforts to realize Smart City in increasing city resilience to climate change, emphasize three concepts: (1) The concept of urban community management; (2) To requires effective and efficient regional management of all resources; (3) Smart City is expected to be able to carry out the function of providing accurate information to the public and be able to anticipate unexpected events. The purpose of this research is to see the implementation of Smart City through Smart Education which focuses on increasing knowledge and community participation. This is aimed at developing a Smart City that is adaptive to disasters due to the impacts of climate change in Bandung City, Indonesia.

16.2 Methodology and Analysis

Bandung City has a strategic value to the surrounding areas, the Bandung City area is directly adjacent to Bandung Regency in the east, south, and north (in part), West Bandung Regency in the north, and Cimahi City in the west. Bandung City is surrounded by mountains, therefore Bandung City is a basin (Bandung Basin) which is located at an altitude of +791 m above sea level (asl), with the position of the northern part generally higher than the southern part. The altitude in the north is around +1050 above sea level, while in the south it is around +675 above sea level. Bandung City is fed by two main rivers, namely the Cikapundung River and the Citarum River, and their tributaries. The geological conditions and soil in Bandung City and its surroundings have alluvial soil layers resulting from the eruption of Mount Tangkuban Parahu. The type of material in center, west, and north Bandung City is the Andosol type in generally. Whereas the southern and eastern parts consist of alluvial with clay deposit material (BPS Bandung City, 2020). Bandung City is vulnerable to the impacts of climate change and disasters (Directorate General of Spatial Planning & Directorate of Regional Planning, 2016) (Fig. 16.1).

In 2019 the average air pressure reached 923.7 millibars, and the air pressure in Bandung City changes throughout the day, in addition to being influenced by altitude, it is also influenced by the air temperature at that time. With a fairly high average air pressure reaching 923.7 millibars and a relatively low air temperature reaching 23.7 °C, the climate and weather conditions in Bandung tend to be humid and the air cool, especially in the morning, relative humidity in 2019 is at 74.25% (BPS Bandung City, 2020). The average temperature in Bandung City in 2019 reached 23.7 °C, where the highest average temperature occurred in October which reached 24.9 °C and the lowest temperature occurred in July reaching 22.7 °C. Rainfall in 2019 fluctuated quite a lot, making it difficult to develop the right strategy to anticipate

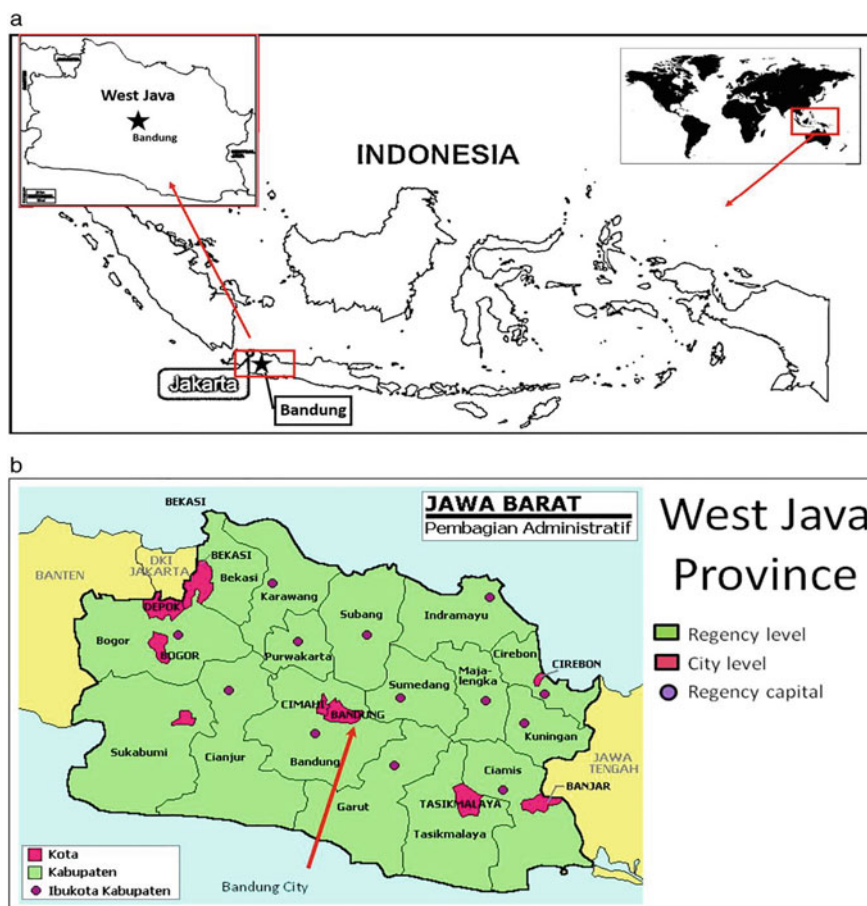


Fig. 16.1 Map of Bandung City in Indonesia's West Java Province. *Source* Taken from BPS Banudng City (<https://bandungkota.bps.go.id/publication/2020/04/27/0a1cfa49906db067b3fb7e5e/kota-bandung-dalam-angka-2020.html>), 2022

the adverse effects of climate change. The total rainfall in Bandung City throughout 2019 reached 2,031.5 mm. The highest rainfall occurs in December with 313.5 mm, while the lowest rainfall occurs in August with only 0.2 mm (BPS Bandung City, 2020).

Seeing the geographic conditions prone to natural disasters, education management in Bandung City seeks to complete a reliable education infrastructure management system. This is to adapt to the threat of disasters and vulnerability of the city due to the impact of climate change, which is realized through Smart City (Ministry of Education and Culture, 2019). Data from the Ministry of Religion for the 2019/2020 school year recorded that there were 70 Ibtidaiyah Madrasas, 43 Tsanawiyah Madrasas, and 26 Aliyah Madrasas in Bandung City. Based on the

results of the National Socio-Economic Survey (SUSENAS, 2019), it is known that 40.31% of the population aged 15 years and over have the highest diploma completed at the high school level. The percentage of the population with elementary to doctoral degrees is relatively smaller, namely 16.95% (BPS Bandung City, 2020).

Based on the results of the 2019 National Socio-Economic Survey (*Survei Sosial Ekonomi Nasional*, SUSENAS), it can be seen that 72.06% of the population aged 5 years and over have the status of no longer in school, and 3.75% have the status of no/never been to school. Of the entire population who are still in school, if broken down according to their education level, 9.95% are at the elementary schools level, 3.85% are at the middle schools level, as many as 4.89% are at the senior high schools level, and 5.5% are at the university level.

According to Dempsey et al. (2012) and Nuzir & Dewancker (2014) education is the key to sustainable urban development, education has always been an important part of the development of society as a factor of change towards a civilization. In addition, the construction of various educational facilities, information systems, and the use of technology have contributed significantly to the development of urban areas. Bandung City's school enrollment rate in 2019 for the age of 7–12 years is 99.80%, meaning 99.80% of the population aged 7–12 years undergoing the education. An increase in school enrollment was seen in the 16–18 year age group. Aged of 16–18 years, 80.38% of them underwent education, aged 13–15 year age group they been decline in school participation. Of the entire population aged 13–15 years, 96.47% of them underwent education. The decline in school participation was also seen in the 19–24 year age group, 39.12% of whom underwent education. Of course, this must be a concern because education is important to improve the quality of society, build urban resilience and create a smart city in Bandung (BPS Bandung City, 2020).

This study uses a qualitative-explorative research method with a phenomenological approach (Creswell & Poth, 2016) in Bandung City. The qualitative approach was chosen because this study tries to describe the views of the researcher as a whole and seeks to reveal the deep truth about adaptive capacity in education to build human resources in the context of resilience from urban threats due to climate change to create a smart city in Bandung City.

Based on smart city data in increasing city resilience and minimizing community vulnerability through education, researchers collected data through literature study techniques and field observations. The data analysis technique that used was interactive analysis (Miles et al., 2018) to analyze all data obtained from observation data, field observations, and documentation obtained. The data obtained from this study will be analyzed by reducing the data which will be examined by the researcher and the main points will be retrieved and presented in the form of narrative data and conclusions will be drawn by the researcher from the data, and then assisted by the Nvivo 12 pro tool as a qualitative research analysis tool to get more satisfactory research results (Woolf & Silver, 2017). In this study, researchers offer the most effective and ideal method for increasing urban resilience and minimizing community vulnerability due to climate change that characterizes the world through a strategy to improve human resources through education. The impact increasing

understanding of disaster-resistant adaptive capacity due to climate change, and increasing community-based participation in urban resilience to the threat of climate change in the disaster-prone city of Bandung.

16.3 Discussions and Results

16.3.1 *Smart City as a Resilience for the Bandung City in Facing Vulnerability*

Position of Bandung City is above a mountain plate, utilizing information systems and technology through the implementation of smart cities in encouraging the adaptation capacity of Bandung City in dealing with natural disasters due to climate change. Natural disasters are disasters caused by events or a series of events caused by nature, such as those that threaten the resilience of Bandung City, earthquakes, volcanic eruptions, floods, droughts, hurricanes, and landslides (Directorate General of Spatial Planning & Directorate of Regional Planning, 2016). The disaster conditions are further explained as follows:

Bandung City as a landslide-prone area is categorized into 4 categories, namely (1) high landslide-prone areas, (2) moderate landslide-prone areas, (3) low landslide-prone areas, and (4) very low landslide-prone areas. Bandung City located between mountains of the island of West Java, Indonesia. Causing a high level of threat of natural disasters due to the impact of climate change that occurred in Bandung City. The following is a description of the distribution of landslide disaster areas in Bandung City (Fig. 16.2).

The High Landslide Prone Area with the highest area is in Ciumbuleuit Village, Cidadap District with an area of 402 Ha, Medium Disaster Area with the highest area is in Ciumbuleuit Village, Cidadap District with an area of 228 ha, Low Landslide Prone Area with the highest area is in Sukawarna District, Sukajadi Village with an area of 206 Ha and Very Low Landslide Hazard Areas with the highest area being in Makarmulya Village, Rancasari District with an area of 436 Ha. Figure 16.2 above shows that most disaster-prone area indicated by the yellow label and the lowest level of landslide susceptibility indicated by the green color.

To build city resilience and minimize community vulnerability due to the impact of climate change disasters in Bandung City, a smart city collaboration in Bandung City to realize the smart city concept is to look at the implementation of sister city cooperation between Bandung City and the city of Braunschweig (Germany) USA, Suwon, Liuzhou, and Seoul. The implementation of the smart city collaboration (Prianto, 2012, 2014; Abdillah et al., 2020; Maulana, 2021; Prianto et al., 2022) in Bandung has succeeded in realizing the smart city concept in the dimensions of a smart city, namely smart environment, smart society, smart education, smart health, smart surveillance, smart governance, and smart payment (Haris et al., 2014; Mursalim, 2017; Muttarak & Lutz, 2014). Indicator of success by implementing

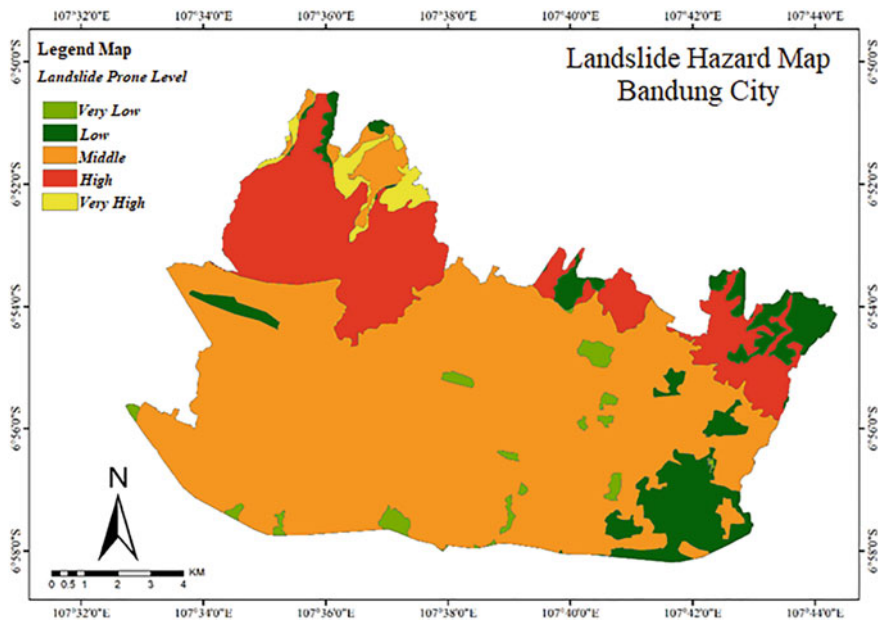


Fig. 16.2 Map of Disaster-Prone Areas such as Landslides in Bandung City. *Source* Taken from (Fitri, N.R., 2021: <https://mapid.co.id/blog/61b2bf01a29c7305d3750afc>), 2022

smart city in Bandung can be seen from the technological solutions used to deal with difficult situations, with strategic planning, efficient leadership, focus on human resource development, effective policies, ecosystems, incentives, and talent in determining the success and effectiveness of the technology applied. In addition, the city also considered capable of collaborating and partnering with other stakeholders from the public and private sectors, using solutions and digital data to provide services and make decisions while considering the implications for inclusion and public trust.

In implementing smart city in Bandung in 2018–2023, there are seven (7) factors of a smart city, such as (1) strategic planning, (2) efficient leadership, (3) focus on human resource development, (4) effective policies, (5) ecosystems, (6) incentives, and (7) talent in determining the success and effectiveness of the technology applied (Prianto et al., 2022; Maulana, 2021). These factors can increase the resilience of the city and minimize the vulnerability of the community due to the impact of climate change. In other words, to increase adaptive capacity face the threat of climate change in the city, through education with the development and improvement of human resources. This factor is the focus of discussion in this study, where the implementation of smart education is one of the strategic steps to face the challenges of climate change.

From Fig. 16.3 above, describe the analyzed of efforts to realize the Bandung City as a smart city through the development of human resources to increase the resilience of the city and minimize the vulnerability of the community due to the threat of natural disasters due to climate change (Faisah & Prianto, 2015). Implementation

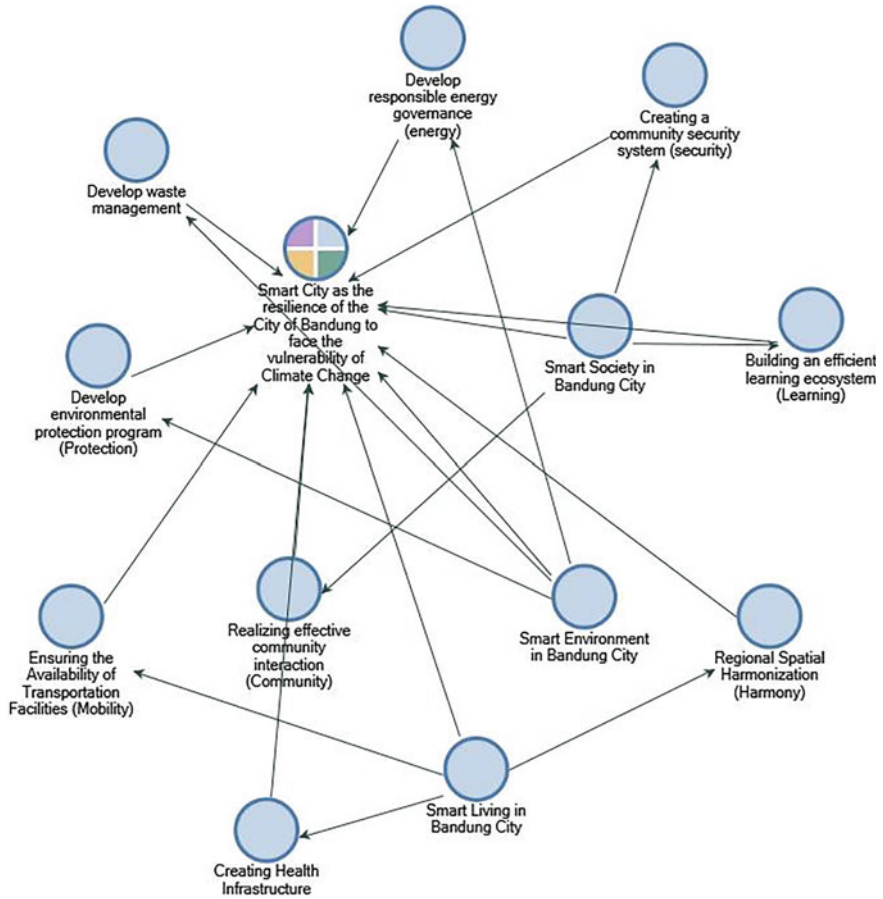


Fig. 16.3 Dimensions of the smart city development strategy in Bandung City. *Source* Researcher from Bandung City smart city Master Plan 2018–2023 Using Nvivo 12 Pro

of education through utilizing technology-based, information systems, and digitalization networks. This has an impact on building an efficient learning ecosystem to instill an understanding of the threat of climate change as well as provide insight in dealing with it. Smart cities are made to help various community activities and provide easy access to information for the community. Smart city implementation emphasizes three concepts, first, the concept applied by the local government system in managing urban communities. Secondly, the concept of regional management of all resources effectively and efficiently (Chienwattanasook & Prianto, 2018; Prianto et al., 2021) and the three smart cities are expected to be able to carry out the function of providing information appropriately to the public and be able to anticipate unexpected events. The smart city concept is also a strengthening of community

participation in encouraging city resilience and reducing the impact of community vulnerability due to climate change in Bandung City which brings disaster.

Based on Mursalim research (2017) focus of his research is in Bandung City where Bandung City has won the 2015 smart city Award event held by Asia's Tech Ecosystem magazine. Smart people and smart living as an effort which is interpreted as the formation of a civil society (a prosperous, safe, and happy society) in the city and with a disaster response perspective (a community that is knowledgeable about adaptive actions to respond to disasters due to climate change) as intelligent people on implementation smart city in Bandung. From the two dimensions of the mission, the so-called smart people will be created because humans are the main actors in realizing a smart city, so the earliest intelligence must start from the humans themselves. Bandung City has built many parks which are expected to be comfortable and healthy places for recreation for its people. One of the factors that encourage realization of a smart city in Bandung is the increase the quality of a comfortable environment for the community (smart living) in the city (Kompasiana, 2015). Development of city park in Bandung that provides comfort (smart environment), sustainable resources, and physical and non-physical beauty, directly or indirectly becomes a pride for the people of Bandung itself. The impact of climate change which brings many disasters such as floods, landslides, or fallen trees on the streets, become the reason the Bandung City government has taken serious attention to the city's environmental sector. So that this can strengthen the resilience of the city and minimize the vulnerability of the community through the factors of smart people, smart environment, and smart living.

Strengthening participation is carried out in encouraging the smart city program in Bandung City so that the community becomes the main subject of development. Bandung City Government's breakthrough in strengthening community participation by increasing the degree of participation towards community control as the highest level of participation. Bandung City Government represent local community participation in three ways, namely collaboration, decentralization, and innovation (Jermisittiparsert et al., 2018; Nurmandi et al., 2015). This is done so that the community has responsibility for the development carried out by the government. The most important innovation in facing the digital/millennial era is by making changes to more casual and egalitarian participation. All communities have access and can be directly involved in participating with the city government in development (Ramdani & Habibi, 2017).

Innovations developed in city of Bandung as a Smart city, it is realized through a collaborative process (participation of every urban actor), and decentralization (support from central government policies, and interactions between local government and with community) to successfully build Bandung City (Jermisittiparsert et al., 2019a, 2019b; Jermisittiparsert, 2018). The concept of a smart city through education in Bandung realizing smart people and smart living as a process of involving the community in evaluating government performance openly in urban development, increasing city resilience, and minimizing community vulnerability due to the impact of climate change disasters that occurred in Bandung City. So the innovation for smart people and smart living is the formation of learning to implement E-Learning-based

education in mixed learning in capacity building, and the quality of the people of Bandung City in the development of Bandung City.

16.3.2 Education Solution for Vulnerability and Resilience in Smart City Bandung

Education is very important in the development of a nation or state, without education in a nation, it is felt that the nation will be left behind by other nations. Education is an organized, planned, and sustainable effort (continuous throughout life) with the aim and direction to develop human beings/students to become better individuals in carrying out their lives where one's life includes maturity and being civilized (Anderson,).

As in the research conducted by Muttarak and Lutz (2014) an educated society is assumed to be more empowered and more adaptive in responding to, preparing for, and recovering from disasters. Indeed findings from eleven original empirical studies set in diverse geographic, socioeconomic, cultural, and hazard contexts provide consistent and strong evidence of the positive impact of formal education on vulnerability reduction.

According to Anderson (2012) that the education sector is an untapped opportunity to combat climate change. Anderson (2012) establishes a comprehensive and multidisciplinary definition of climate change education for sustainable development in areas and asserts that it must not only include knowledge of relevant content on climate change, environmental and social issues, disaster risk reduction, and sustainable consumption and lifestyle. This is the reason why this research was carried out which focused on the institutional environment in which the content was studied to ensure that the schools and education systems themselves promote climate change resilience, as well as being sustainable and green.

In the study of climate change risks in building (Sriyakul et al., 2019a, 2019b; Sutduean et al., 2019; Jermstittiparsert et al., 2019a, 2019b) a smart city in Bandung City, it aims to increase community participation in urban resilience and community vulnerability. In increasing the adaptive capacity of the Bandung City community through education, referring to the Bandung City planning based on the smart city concept to increase city resilience, community learning, and building a smart environment (Bandung City Government, 2018: 20–37; Directorate General of Spatial Planning & Directorate of Planning Region, 2016: 67–70), such as (Table 16.1).

The implementation of smart cities through education faces the threat of climate change in Bandung City, strategy for the development process is carried out through smart people and smart living factors. These factors seek the formation of learning to organize education based on E-Learning in mixed learning in increasing the capacity and quality of the people of Bandung City in developing smart cities. As an effort of adaptive capacity through education which aims to build the actions of adaptive capacity of the people by utilizing technology and information that is currently

Table 16.1 Increasing the adaptive capacity of the smart city Bandung community through education

No	Category	Explanation
1	Landslide risk projection	Landslide risk prediction is taken from vulnerability factors and dynamic rainfall factors, then the future risk status can be determined. Information related to the increasing trend or trend of potential disaster-prone that is influenced by rainfall and the trend of increasing urban vulnerability (a trend implicit in the development process). Bandung City tends to increase rainfall, if it is associated with the occurrence of landslides, it can be concluded that Disaster-Prone Areas landslides can increase in the range of 0–10% rainfall. In terms of vulnerability, the conditions for determining the increase in vulnerability are population (21.34%), percentage of construction land (12.57%), and population density (8.21%). Based on this, it can be concluded that due to the increasing trend of vulnerability and the increasing probability of landslide-prone areas in Bandung City (priority areas of Cedardap, Chibiru, and Ujungerang), the risk of this projection may increase
2	Drought risk projection	According to data from Mulyana (2002), a significant decrease in rainfall has an impact on increasing drought-prone areas in Bandung City. The increase in drought-prone areas has a major impact on increasing the risk of urban disasters, such as the difficulty of getting clean water for the community. This is based on the fact that Bandung City tends to increase rainfall, if it is associated with the drought disaster of Disaster-Prone Areas, it can be concluded that the KRB drought can decrease between 0 and 10%. In terms of vulnerability, the requirements to determine the increase in vulnerability are population (21.34%), percentage of construction land (12.57%), and population density (8.21%). Based on this, it can be concluded that compared to drought-prone areas in Bandung the level of vulnerability is higher, so the predicted risk can increase (Endarwati et al., 2016)

(continued)

Table 16.1 (continued)

No	Category	Explanation
3	Flood risk projection	<p>This flood risk prediction condition was made to determine future risk conditions originating from vulnerability and dynamic rainfall factors. The tendency of increasing vulnerability disasters is influenced by rainfall, where a positive correlation between increased rainfall and flood discharge (Kodoatie, 2002; Endarwati et al., 2016), in addition, it also shows a tendency to increase urban vulnerability in the development process. Based on the analysis of rainfall forecasts for the next 25 years, it can be concluded that Bandung City tends to increase rainfall, if it is associated with Disaster-Prone Areas (<i>Kawasan Rawan Bencana</i>, KRB) flooding, it can be concluded that Disaster-Prone Areas (<i>Kawasan Rawan Bencana</i>, KRB) flooding can increase between 0 and 10%. From the point of view of vulnerability prediction, the increase in vulnerability status is determined by the following indicators: population (21.34%), percentage of construction land (12.57%), and population density (8.21%). Based on this, it can be concluded that the increasing level of vulnerability in Bandung City, it is due to the percentage level of areas that are potentially affected by flooding. The area is located in the street of Cinambo Sub-District, Gedebage Sub-District, Arcamanik District, Buah Batu Sub-District, Bandung Kidul Sub-District, and Antapani Sub-District in Bandung City. This has an impact on increasing the level of urban vulnerability that occurs in Bandung City due to climate change</p>

Source Processed from various sources, 2021

developing. Therefore, the blended learning model that has been applied in Bandung City was chosen as E-Learning Smart Education in socializing adaptive actions for natural disasters due to climate change and encouraging community participation in city development through smart cities (Juanda et al., 2020; Heryanto et al., 2021; Kristanto & Mariono, 2017).

The development of blended learning teaching materials is based on the steps in the development of the Research & Development (R&D) model (Suartama et al., 2019; Tryanto et al., 2021). The following is a description of the development of mixed learning model teaching materials: (1) Research and Information Gathering The first step taken by researchers in developing a blended learning model of teaching materials in the development of audio/radio media courses for students majoring in Educational Curriculum and Technology, Faculty of Education, State University Surabaya, Indonesia, conducts research and collects information; (2) Planning, blended-learning is very suitable for the audio/radio media development course. The model is a combination of face-to-face learning and online learning. This was done because errors were found in the course. Then a Semester Lesson Plan (SLP) draft and web flowchart were made. For the process to run well, the researchers did get data on the facilities owned by the students used to execute the models that had been prepared. Based on the data collected through classroom observation, it was obtained that 47 students had laptops, a total of 39 units; 35 portable sport wifi units; 34 units of gadgets; and six (6) personal computers (Fig. 16.4).

Production, in developing this blended learning model, in making an e-learning system, a program called Popoji CMS which is a content management system used to create concepts in e-learning, the program is also the main program used. In the production process, there are several support programs such as Adobe Photoshop CS3, CorelDraw X4, and MS 2010. Adobe Photoshop CS3 is used for image editing;

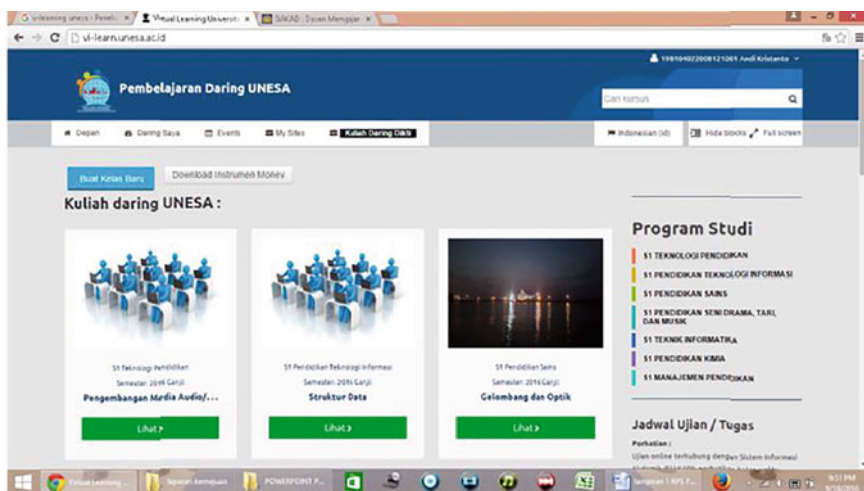


Fig. 16.4 E-learning design. Source Kristanto & Mariono (2017:10–17), 2021

it will be edited into such a format for use in media. CorelDraw X4 is used to create images and set the image size used in the media. MS 2010 is used to process the data needed on the web that will be displayed in blended learning. Materials Included: these materials are lecture guide materials which include Semester Lesson Plans (SPL), guidelines for the use of e-learning, material, and practice guidelines; it is available in soft file.

From the blended learning model applied in Bandung City (Kristanto & Mariono, 2017; Juanda et al., 2020; Heryanto et al., 2021) namely utilizing information and technology in the implementation of the smart city concept in Bandung City. Increase the adaptive capacity of people in Bandung through education that is held effectively and efficiently according to the demands and developments of the times, disaster response education in Bandung City utilizes information systems, technology, and regulations that support the implementation of smart cities in Bandung City, due to the high level of disasters in the last 10 (ten) years in Bandung City, Indonesia due to climate change (Directorate General of Spatial Planning & Directorate of Regional Planning, 2016). Therefore, the concept of the smart city in smart people, smart environment, and smart living through education as a strategy for Bandung City in increasing the adaptive capacity of the community to face disasters due to the impact of climate change (Zarkasi & Rahardian, 2022; Malik et al., 2021) in Bandung City which will increase the resilience of the city and minimize the vulnerability of the people of Bandung.

In Addition, in Bandung City, the Education for Sustainable Development (ESD) (Nurhidayah, 2014) educational learning model is applied and adaptive action against climate change is designed to encourage public awareness as a whole, build a character of love for the environment and implement environmentally friendly daily life. Through ESD, it is hoped that it can change the paradigm and behavior of all components of society, especially the world of education to participate in implementing the four pillars of sustainable development, including aspects of just and sustainable economic development, environmental conservation, developing social resilience, and maintaining cultural diversity.

16.4 Conclusion

The findings that concluded education is a percentage of disaster response actions in Bandung City, Indonesia. Have affects in human development, city resilience, and environmental sustainability due to the impact of climate change in Bandung City. The E-Learning Smart Education model and Education for Sustainable Development (ESD) as education plan developed in Bandung City it is effort to deal with a weak level of education towards a more effective and efficient insight into disaster response actions integrated with information systems, digital networks, and technology. Weak quality, availability, and access to education harm urban development. This weakness hinders the diversification of livelihoods and further reduces the adaptive capacity of the people in Bandung City. Furthermore, the low level of public education has limited

their awareness and participation in preventing and benefiting from interventions and has also influenced decisions about education to increase adaptive capacity to fight the adverse effects of natural disasters.

Blended learning model is applied in Bandung City to utilize information and technology in application of the smart city concept in Bandung to increase the adaptive capacity of the Bandung community through effective and efficient education. Following the demands and developments of the times that use technology, information systems and network systems (digitalization) are the steps for implementing smart cities in Bandung, considering the last ten years the high level of disasters in Bandung City due to the impact of climate change that occurred. Therefore, the concept of a smart city on the factors of smart people, smart environment, and smart living through education is the strategy of Bandung City in increasing the adaptive capacity of the community in dealing with disasters due to the impact of climate change in Bandung City. It is also an effort to increase the resilience of the city and minimize the vulnerability of Bandung people.

As one of the countries that are vulnerable to the impacts of climate change, Bandung City should take a role in efforts to tackle global warming and climate change, by seeking to reduce greenhouse gas (GHG) emissions in the energy sector and LULUCF (Land-Use, Land-Use Change and Forestry) and increase carbon absorption. To realize and carry out various efforts to prevent and hinder the occurrence of climate change, collaboration, both external and internal, is needed. Bandung City invites several regions in Indonesia to fulfill their commitments to reducing GHG emissions and through local governments to form commitments to reduce GHG emissions by jointly improving development patterns that internalize the environmental paradigm in various development sectors. Starting from integration in the planning and implementation of development programs to deal with the threat of climate change.

limitations of this study do not highlight public funding for climate change control in Bandung City. So that this research is limited the studying in commitment of the Bandung city government and funding needs to controll regional climate change, as well as understanding the sources of funding for climate change control in Bandung City. So the researcher recommends for future research focus on studies on the analysis of public funding for climate change control in Bandung City, to complete the shortcomings in this research.

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